

REMARKS/ARGUMENTS

Claims 39-47 have been cancelled from the application without prejudice, in response to the Restriction Requirement dated October 18, 2007. Claim 29 has been amended, claims 33 and 35 to 37 have been cancelled from the application, and new claims 48 to 59 have been added to the application. Claims 29 to 32, 34, 38 and 48 to 59 are pending in the application.

The rejections raised in the Office Action are addressed as follows.

Claim rejections under 35 U.S.C. 103

The Examiner rejected claims 29-32 and 38 under 35 U.S.C. 103(a) in view of admitted prior art (APA), U.S. Patent No. 6,697,276 (Pereira 276) and U.S. Patent Publication No. 2002/0015348 (Gillingham). In response, claim 29 has been amended to recite the features of claims 36 and 37. Accordingly, claims 36 and 37 have been cancelled from the application.

The Examiner rejected claims 33 and 34 under 35 U.S.C. 103(a) in view of APA, Gillingham, Pereira 276 and US Patent No. 6,108,227 (Voelkel). Claim 33 has been cancelled, and in view of the amendments to claim 29, Applicant submits that claim 34 is unobvious.

The Examiner rejected claims 35 to 37 under 35 U.S.C. 103(a) in view of APA, Gillingham, Pereira 276 and Pereira 970. Claims 35 to 37 have been cancelled from the application.

Amended claim 29

Applicant submits that the amended claim 29 is not obvious in view of combinations of APA, Pereira 276, Gillingham and U.S. Patent No. 6,191,970 (Pereira 970). Applicant's reasoning is as follows:

Amended claim 29 is directed to a content addressable memory having in part, rows of matchlines, where each matchline row includes a first matchline segment and a second matchline segment both precharged to a voltage level corresponding to a miss condition. Ternary cells are connected to the first matchline segments while binary cells are connected to the second matchline segments. Matchline sense amplifiers are connected to

the first matchline segments and the second matchline segments, each of the matchline sense amplifiers detecting either the miss condition or a match condition of the matchline segment it is connected to.

First, Applicant submits that the combination of APA, Pereira 276, Gillingham and Pereira 970 does not disclose or teach ternary CAM cells connected to one matchline segment and binary CAM cells connected to a different matchline segment. Pereira 276 infers that both types of CAM cells can be connected to one matchline, while Pereira 970 discloses that both matchline segments ML_a and ML_b have the same type of CAM cells connected to both of them. Accordingly, there is no indication in either Pereira 970 and Pereira 276 of how two different types of CAM cells are distributed amongst the two matchline segments. The Examiner believes that Pereira 276 implies at column 34, lines 19-23 that the claimed arrangement is desirable according to application needs. Applicant respectfully disagrees, and submits that Pereira 276 is actually stating that the number of binary and ternary CAM cells to use in one row depends on how many hash index bits are required. Earlier in column 34, Pereira 276 states that a ternary CAM having a 16 bit storage width may be used to store a full 16 bit hash index, with mask information to mask out selected bits of the hash index. Accordingly, the ternary CAM cells can store a mask bit to effectively mask the cell to achieve this desired result. In fact, the purpose of masking bits is to prevent them from being searched. On the other hand, Pereira 970 intends to search all the bits of both segments ML_a and ML_b. Therefore, it is unclear how a person skilled in the art would understand to arrive at the claimed arrangement of CAM cells when the purpose of using the binary and ternary CAM cells of Pereira 276 has nothing to do with the physical arrangement of different CAM cells on different matchline segments. In other words, Pereira 276 does not provide any indication that binary CAM cells can be connected to one matchline segment while ternary CAM cells can be connected to another matchline segment. Furthermore, Pereira 970 teaches power savings by using segmented matchlines, but saving power is independent of which CAM cells are on which matchline segment. Once again, this does not direct a person skilled in the art to the claimed arrangement of CAM cells.

According to the USPTO examination guidelines for determining obviousness, one of the rationales for supporting a conclusion of obviousness of a claim is: **(A) Combining prior art elements according to known methods to yield predictable results**. This rationale requires:

(1) a finding that the prior art included each element claimed, although not necessarily in a single prior art reference, with the only difference between the claimed invention and the prior art being the lack of actual combination of the elements in a single prior art reference;

(2) a finding that one of ordinary skill in the art could have combined the elements as claimed by known methods, and that in combination, each element merely performs the same function as it does separately; and

(3) a finding that one of ordinary skill in the art would have recognized that the results of the combination were predictable.

Applicant submits that items (2) and (3) above are not satisfied because matchline segments having different types of CAM cells as claimed would not have been recognized as a predictable outcome by a person skilled in the art having the combination of Pereira 276 and Pereira 970. A person skilled in the art simply has no reason for applying the teachings of Pereira 276 to the segmented matchlines of Pereira 970. There are no power saving advantages to using different types of CAM cells for different matchline segments, and Pereira 276 does not imply anywhere that the different types of CAM cells should be for different matchline segments.

Second, Applicant submits that the combination of APA, Pereira 276, Gillingham and Pereira 970 does not disclose or teach first and second matchline segments precharged to a voltage level corresponding to a miss condition. Pereira 970 does not even have a matchline sense amplifier connected to ML_b. Applicant takes the opportunity to point out that applying the Gillingham precharge to miss condition sensing scheme to the segmented matchline memory of Pereira 970 would not work to achieve the desired power savings result of Pereira 970.

Pereira 970 expressly teaches that the purpose for segmenting the matchlines is to reduce power consumption by preventing discharge of the second matchline ML_b from the precharged VDD voltage to VSS, via the discharge circuits of the CAM cells. Pereira 970 teaches that if the first matchline segment ML_a reports a miss condition, then ML_b remains at the VDD precharge level, and hence does not have to be precharged again for the next search and compare operation. In Pereira 970, the precharge VDD voltage on the matchline corresponds to a match condition while a VSS voltage on the matchline corresponds to a miss condition.

The Gillingham precharge to miss sensing scheme discloses an embodiment where matchlines are precharged to VSS, which corresponds to a miss condition while a matchline voltage at about VDD corresponds to a match condition. During a search and compare operation, a current source applies a current to raise the voltage of the matchline, while discharge circuits may or may not be active for sinking the current to VSS. After a predetermined period of time, the matchline voltage is sensed to be either above or below some predetermined reference level. If there is a match, meaning that no discharge circuits are active, then the matchline will rise to VDD quickly. On the other hand, if there is more than one mismatch, then the matchline voltage will rise towards VDD slowly.

Applicant submits that the precharge to miss scheme taught by Gillingham as applied to the segmented matchline system of Pereira 970 will not work to achieve the power savings desired by Pereira 970. If both ML_a and ML_b are precharged to the miss condition voltage VSS as implied by the Examiner, ML_a reporting a miss condition will turn off the discharge circuits 30b of the CAM cells, as shown in Figure 4 of Pereira 970. However, according to the Gillingham sense scheme, a current would be applied to ML_b. Therefore, ML_b will rise to VDD quickly since the discharge circuits are disabled. However, to prepare for the next search and compare operation, ML_b must be precharged back to the miss condition of VSS. Therefore, power is wasted since the VDD level of ML_b from the previous operation must be discharged to VSS. This will occur each time there is a miss condition on ML_a. An advantage of the presently claimed segmented matchline scheme is to save power, which is not attained at all by the modified Pereira 970 segmented matchline system with the Gillingham precharge miss sensing scheme.

According to the USPTO examination guidelines for determining obviousness, one of the rationales for supporting a conclusion of obviousness of a claim is:

(D) Applying a Known Technique to a Known Device (Method, or Product) Ready for Improvement To Yield Predictable Results.

(1) a finding that the prior art contained a "base" device (method, or product) upon which the claimed invention can be seen as an "improvement;"

(2) a finding that the prior art contained a known technique that is applicable to the base device (method, or product); and,

(3) a finding that one of ordinary skill in the art would have recognized that applying the known technique would have yielded predictable results and resulted in an improved system.

Applicant believes that the “base” device is the segmented matchline system of Pereira 970, while the known sensing technique is the Gillingham precharge to miss sensing scheme. Applicant therefore submits that item (2) is not satisfied because the Gillingham precharge to miss sensing scheme is not applicable and compatible with the segmented matchline system of Pereira 970, for achieving power savings.

Therefore, for the reasons stated above, Applicant submits that amended claim 29 is not obvious in view of the combination of APA, Pereira 276, Gillingham and Pereira 970.

New claim 48

Applicant takes the opportunity to present arguments supporting the novelty of claim 48 over APA, Pereira 276, Gillingham and Pereira 970. New claim 48 recites that the matchline sense amplifier connected to the first matchline segment disables the matchline sense amplifier connected to the second matchline segment in response to the miss condition of the first matchline segment.

Pereira 970 has a match detect circuit 42, as shown in Figure 4, that senses the match or miss condition of ML_a. The output of match detect circuit 42 disables the discharge circuits of the CAM cells connected to ML_b, and not any sense amplifier that senses the state of ML_b.

New claim 49

Applicant takes the opportunity to present arguments supporting the novelty of claim 49 over APA, Pereira 276, Gillingham and Pereira 970. New claim 49, being dependent on preceding claim 48, recites that the matchline sense amplifier connected to the second matchline segment provides a match output if the first matchline segment and the second matchline segment have the match condition.

Pereira 970 does not have a matchline sense amplifier connected to ML_b that receives any signal indicating a match or miss condition provided by the sense amplifier connected to ML_a.

New claim 50

Applicant takes the opportunity to present arguments supporting the novelty of claim 50 over APA, Pereira 276, Gillingham and Pereira 970. New claim 50 recites that the second matchline segment is at the voltage level corresponding to the miss condition when the first matchline segment is at the voltage level corresponding to the miss condition. For example, if the first and the second matchline segments are precharged to a miss condition then they are precharged to VSS, according to an embodiment taught by Gillingham.

Pereira 970 precharges both ML_a and ML_b to VDD prior to a search and compare operation, which corresponds to a match condition. Pereira 970 clearly teaches that if ML_a is discharged due to a miss condition, then the discharge circuits 30b of the CAM cells are disabled and ML_b remains at the precharged match condition voltage of VDD. The purpose being to save power by preventing discharge of ML_b.

In the previously discussed hypothetical segmented matchline system of Pereira 970 using the Gillingham precharge to miss sensing scheme, in the event of a miss condition on ML_a, the discharge circuits 30b connected to the CAM cells of ML_b turn off. However, the current source of the matchline sense circuit remains on and ML_b eventually charges to VDD; the match condition voltage level.

New claim 51

Applicant takes the opportunity to present arguments supporting the novelty of claim 51 over APA, Pereira 276, Gillingham and Pereira 970. New claim 51 recites that the ternary cells connected to the first matchline segments are searched in a first search and compare cycle, and the binary cells connected to the second matchline segments are searched in a second search and compare cycle after the first search and compare cycle. Figure 10 of US Patent No. 6,584,003, which is incorporated by reference, shows how a presearch is executed first on a first matchline segment, followed by a main search executed on a second matchline segment.

Pereira 970 executes a search of the CAM cells connected to both ML_a and ML_b in the same search and compare cycle. This should be clear to a person skilled in the art because AND gate 36 only provides an output indicating at least one miss condition or a match condition for both matchline segments when both sets of CAM cells receive search data.

Summary

In view of the amendments to claim 29, the subject matter claimed in new claims 48 to 59, and the presented arguments, Applicant believes that the pending claims of the application are novel and unobvious in view of the cited references. Applicant looks forward to receiving notice of any allowable claims of the application.

The Commissioner is hereby authorized to charge any additional fees, and credit any over payments to Deposit Account No. 501593, in the name of Borden Ladner Gervais LLP.

Respectfully submitted,

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